Supplementary Information

Text S1. Microwave-assisted digestion procedures for determination of total content of heavy metals.

The powdered soil samples (~0.2 g) were digested by a mixture of concentrated HNO3 (9.0 mL) and 40 % HF (*v/v*, 3.0 mL) in sealed digestion vessels with a TFM liner and a PFA cap. Microwave-assisted digestion of the soil samples was conducted using a MARS 6 microwave digestion system (CEM, USA), according to method 3052 of the U.S. Environmental Protection Agency (USEPA) (USEPA, 1996). The digestion solutions were evaporated to near dryness on an electric hot plate at 95 °C to remove the excess acids and silicon tetrafluoride (SiF4). The residues were re-dissolved with dilute HNO3 and further diluted to 40 mL using ultrapure water. After filtration by 0.45 μm syringe filters, the concentrations of heavy metal(loid)s (As, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, V, and Zn) in the solution samples were determined on a NexION 350D Inductively Coupled Plasma–Mass Spectrometer (ICP-MS, PerkinElmer, USA).

Tables & Figures

Table S1. Potential ecological risk levels based on risk factor of a single trace metal.

Interval	Potential ecological risk level
$E_i < 40$	Low
$40 \le E_i < 80$	Moderate
$80 \le E_i < 160$	Considerable
$160 \le E_i < 320$	High
$E_i \ge 320$	Very high

Table S2. Potential ecological risk levels based on risk index of multiple trace metals.

Interval	Potential ecological risk level
RI＜150	Low
150≤RI＜300	Medium
300≤RI＜600	Strong
RI≥600	Extremely strong

Table S3. Exposure parameter used for health risk assessment to toxic elements.

Exposed parameter	Unit	Adults	Children	Reference
EF: exposure frequency	day/year	350	350	(USEPA, 2011)
ED: exposure years	year	24	6	(USEPA, 2011)
AT: average exposure time (non-carcinogenic effect)	day	365×ED	365×ED	(Jiang et al., 2022)
AT: average exposure time (carcinogenic effect)	day	365×70	365×15	(Jiang et al., 2022)
BW: body weight	kg	63	29	(Liu et al., 2022)
IngR: soil falling rate in ingestion	mg/day	100	200	(USEPA, 2011)
InhR: respiration rate	m^3/day	16	7.6	(Liu et al., 2022)
SA: exposed skin area	cm^2	5700	2800	(Liu et al., 2022)
SAF: skin adherence factor for soil	mg/cm^2/day	0.07	0.2	(USEPA, 2011)
ABS: skin adsorption factor	-	0.001 (As: 0.03)		(Liu et al., 2022)
PEF: particle emission factor	m^3/kg	1.36×10^9	1.36×10^9	(USEPA, 2002)
CF: unit conversion	kg/mg	10^6	10^6	

Table S4. Reference dose (RfD, mg/(kg·day)) and slope factor (SF, $[mg/(kg\cdot day)]^{-1}$) of heavy metals through different pathways (Gujre et al., 2021; Liu et al., 2022; Sun et al., 2020).

	RfD_{ing}	RfD_{der}	RfD_{inh}	SF_{ing}	SF_{der}	SF_{inh}
As	3.00×10^{-4}	1.23×10^{-4}	3.00×10^{-4}	1.50 (Skin cancer), 25.7 (Bladder and lung cancer)	3.66	15.1
Cd	1.00×10^{-3}	1.00×10^{-5}	1.00×10^{-3}	-	-	6.30
Cr	1.5[a]	6.00×10^{-5}	2.86×10^{-5}	-	-	-
Cu	4.00×10^{-2}	1.20×10^{-2}	4.02×10^{-2}	-	-	-
Ni	2.00×10^{-2}	5.40×10^{-3}	2.06×10^{-2}	-	-	-
Pb	3.50×10^{-3}	5.25×10^{-4}	3.52×10^{-3}	8.50×10^{-3}	-	-
Zn	0.300	6.00×10^{-2}	0.300	-	-	-
Mn	4.60×10^{-2}	1.84×10^{-3}	5.00×10^{-5}	-	-	-
Hg	3.00×10^{-4}	2.10×10^{-5}	8.57×10^{-5}	-	-	-

Note:

a - Cr mainly exists in the forms of Cr(III) and Cr(VI), and Cr(VI) will be rapidly reduced to Cr(III) by human gastric juice. Therefore, the RfD value of Cr(III) was chosen to calculate HQ instead of total chromium in the study.

Table S5. Variance explained by the extracted components of PCA analysis for trace metals in Yingtan agricultural soil.

Component	Initial components			Retained components			Rotated components		
	Eigen value	Proportion of variance (%)	Cumulative proportion (%)	Eigen value	Proportion of variance (%)	Cumulative proportion (%)	Eigen value	Proportion of variance (%)	Cumulative proportion (%)
PC1	2.58	28.7	28.7	2.58	28.7	28.7	2.25	25.0	25.0
PC2	1.57	17.4	46.1	1.57	17.4	46.1	1.69	18.8	43.8
PC3	1.18	13.1	59.2	1.18	13.1	59.2	1.16	12.8	56.6
PC4	0.941	10.5	69.7	0.941	10.4	69.7	1.08	12.0	68.6
PC5	0.919	10.2	79.9	0.919	10.2	79.9	1.02	11.3	79.9
PC6	0.736	8.18	88.1						
PC7	0.514	5.71	93.8						
PC8	0.374	4.16	97.9						
PC9	0.185	2.06	100						

Table S6. Source-specific non-carcinogenic risks of heavy metals from different sources.

	Adult							Children						
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Unknown	Total	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Unknown	Total
Ni	2.70×10^{-4}	1.10×10^{-3}	2.22×10^{-6}	7.97×10^{-5}	7.10×10^{-5}	9.67×10^{-5}	1.62×10^{-3}	1.17×10^{-3}	4.77×10^{-3}	9.59×10^{-6}	3.45×10^{-4}	3.07×10^{-4}	4.18×10^{-4}	7.02×10^{-3}
Cr	5.89×10^{-4}	4.07×10^{-3}	2.59×10^{-4}	5.50×10^{-4}	5.28×10^{-5}	5.88×10^{-4}	6.11×10^{-3}	1.73×10^{-3}	1.20×10^{-2}	7.64×10^{-4}	1.62×10^{-3}	1.55×10^{-4}	1.73×10^{-3}	1.80×10^{-2}
Cu	3.65×10^{-4}	2.10×10^{-4}	1.57×10^{-4}	1.38×10^{-4}	1.29×10^{-4}	1.44×10^{-4}	1.14×10^{-3}	3.39×10^{-3}	9.09×10^{-4}	6.81×10^{-4}	5.95×10^{-4}	5.60×10^{-4}	6.22×10^{-4}	6.76×10^{-3}
Zn	3.03×10^{-4}	1.03×10^{-4}	7.51×10^{-6}	1.61×10^{-5}	7.12×10^{-6}	1.48×10^{-5}	4.51×10^{-4}	1.31×10^{-3}	4.44×10^{-4}	3.24×10^{-5}	6.95×10^{-5}	3.08×10^{-5}	6.38×10^{-5}	1.95×10^{-3}
As	1.57×10^{-3}	6.68×10^{-3}	3.54×10^{-2}	3.86×10^{-3}	1.13×10^{-2}	2.86×10^{-3}	6.17×10^{-2}	6.35×10^{-3}	2.71×10^{-2}	0.143	1.57×10^{-2}	4.59×10^{-2}	1.16×10^{-2}	0.250
Pb	1.58×10^{-2}	2.39×10^{-4}	2.80×10^{-4}	1.41×10^{-3}	2.49×10^{-3}	8.49×10^{-4}	2.11×10^{-2}	6.83×10^{-2}	1.03×10^{-3}	1.21×10^{-3}	6.06×10^{-3}	1.07×10^{-2}	3.66×10^{-3}	9.10×10^{-2}
Cd	5.58×10^{-4}	8.95×10^{-5}	2.38×10^{-5}	2.91×10^{-5}	1.75×10^{-5}	1.04×10^{-4}	8.22×10^{-4}	2.22×10^{-3}	3.56×10^{-4}	9.46×10^{-5}	1.16×10^{-4}	6.96×10^{-5}	4.15×10^{-4}	3.27×10^{-3}
Mn	1.41×10^{-3}	5.70×10^{-4}	8.79×10^{-5}	3.65×10^{-3}	6.39×10^{-4}	1.08×10^{-3}	7.43×10^{-3}	5.54×10^{-3}	2.25×10^{-3}	3.47×10^{-4}	1.44×10^{-2}	2.52×10^{-3}	4.24×10^{-3}	2.93×10^{-2}
Hg	4.92×10^{-5}	2.46×10^{-5}	1.47×10^{-5}	2.05×10^{-5}	3.24×10^{-4}	2.33×10^{-5}	4.56×10^{-4}	2.10×10^{-4}	1.05×10^{-4}	6.29×10^{-5}	8.75×10^{-5}	1.38×10^{-3}	9.95×10^{-5}	1.94×10^{-3}
THI_{ing}	1.92×10^{-2}	7.39×10^{-3}	2.79×10^{-2}	7.66×10^{-3}	1.22×10^{-2}	4.28×10^{-3}	7.87×10^{-2}	8.52×10^{-2}	3.21×10^{-2}	0.121	3.33×10^{-2}	5.32×10^{-2}	1.86×10^{-2}	0.344
THI_{inh}	1.62×10^{-4}	2.87×10^{-4}	2.61×10^{-5}	3.59×10^{-4}	6.17×10^{-5}	1.31×10^{-4}	1.03×10^{-3}	1.67×10^{-4}	2.96×10^{-4}	2.70×10^{-5}	3.71×10^{-4}	6.37×10^{-5}	1.35×10^{-4}	1.06×10^{-3}
THI_{dermal}	1.61×10^{-3}	5.41×10^{-3}	8.27×10^{-3}	1.74×10^{-3}	2.75×10^{-3}	1.34×10^{-3}	2.11×10^{-2}	4.91×10^{-3}	1.65×10^{-2}	2.52×10^{-2}	5.30×10^{-3}	8.38×10^{-3}	4.09×10^{-3}	6.44×10^{-2}
THI	2.10×10^{-2}	1.31×10^{-2}	3.62×10^{-2}	9.75×10^{-3}	1.50×10^{-2}	5.75×10^{-3}	0.101	9.02×10^{-2}	4.89×10^{-2}	0.147	3.89×10^{-2}	6.16×10^{-2}	2.28×10^{-2}	0.409

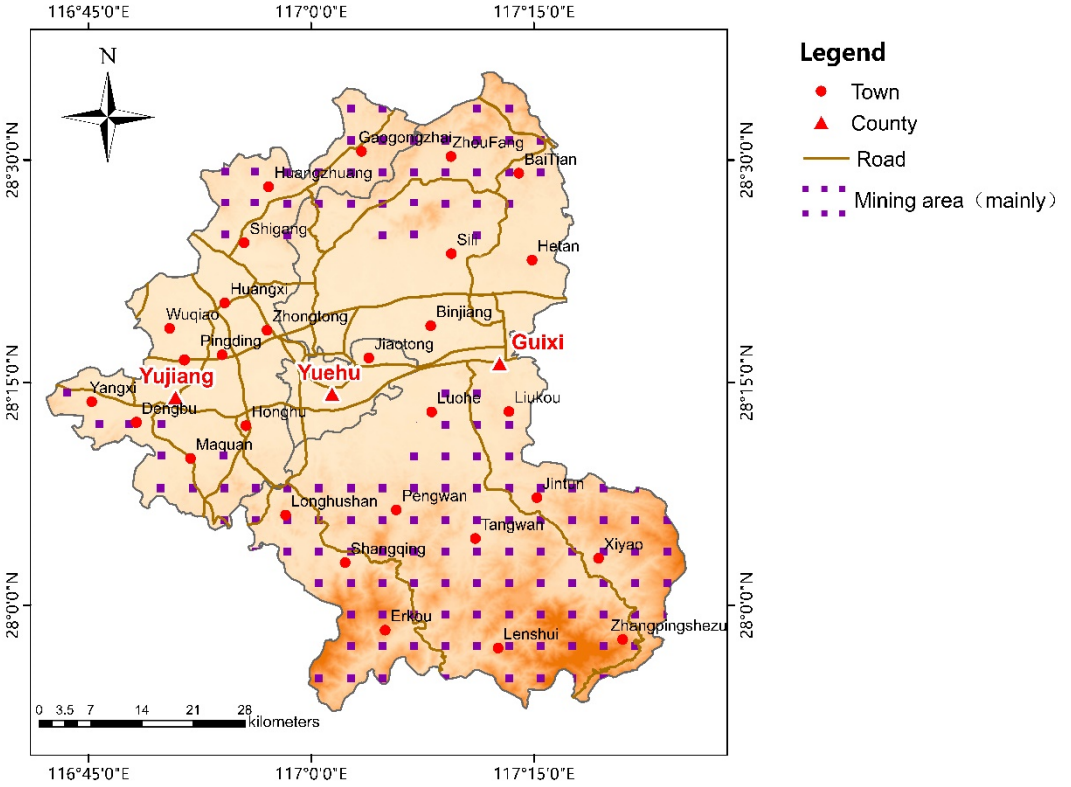

Figure S1. Distribution of the main mining areas, residential areas, and roads in Yingtan.

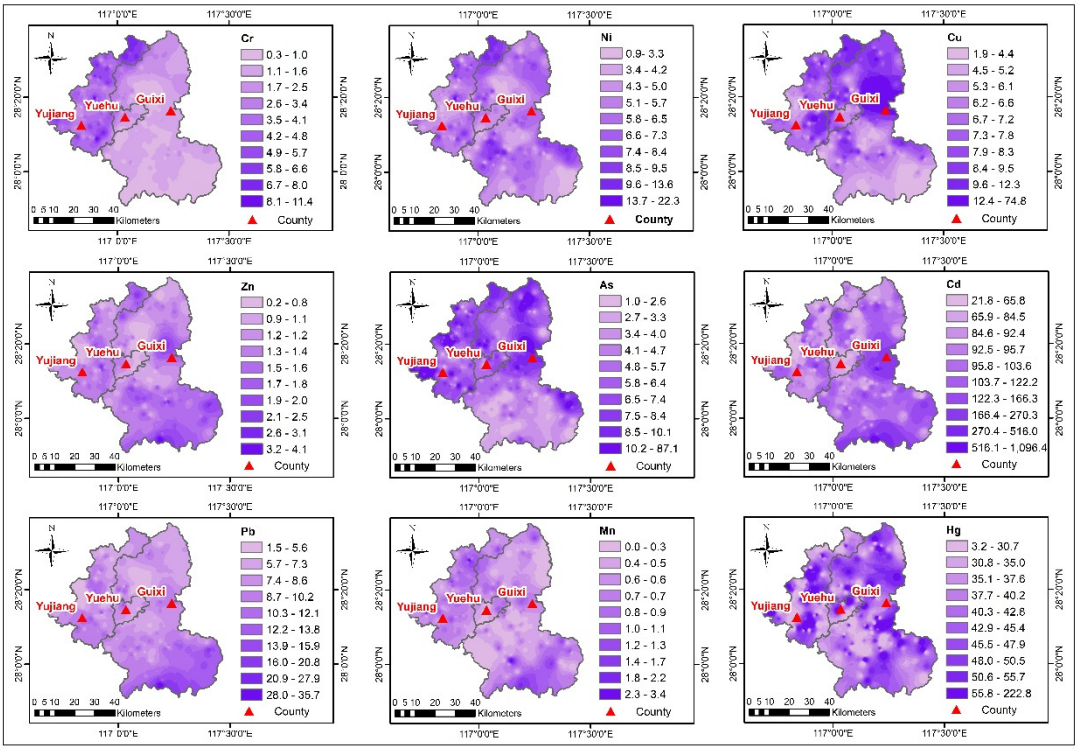

Figure S2. Spatial distributions of single risk factors of trace metals in Yingtan agricultural soils.

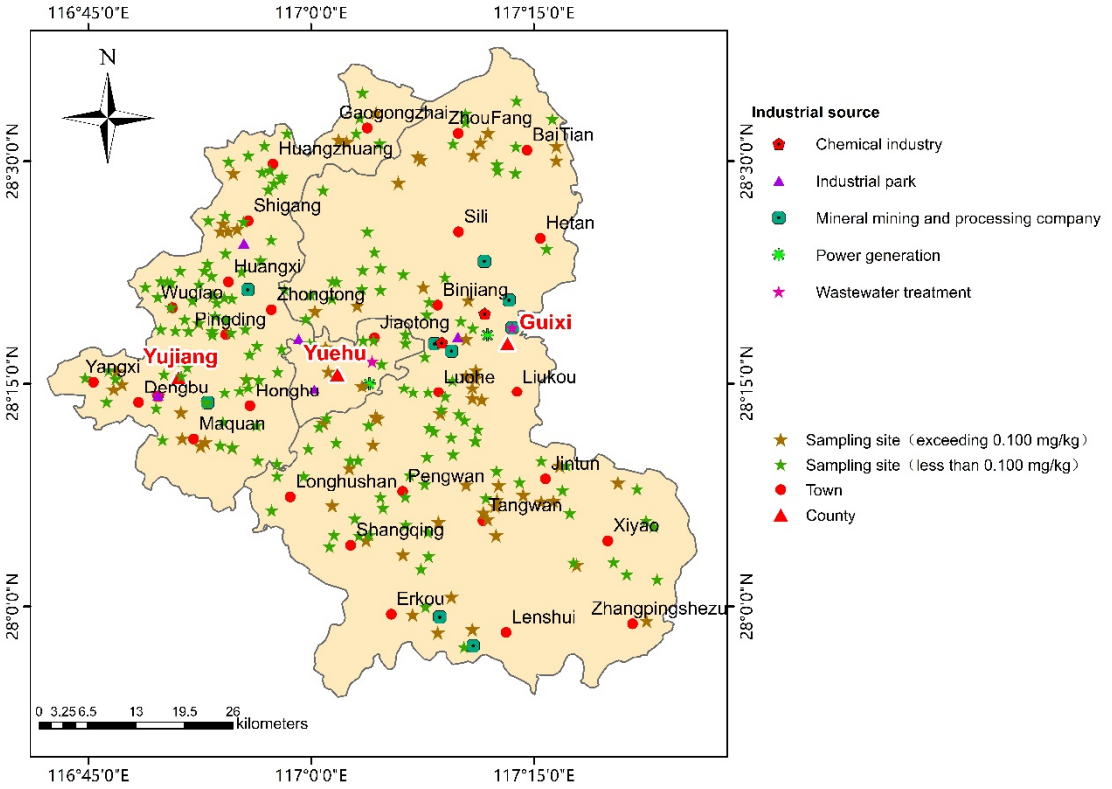

Figure S3. Spatial distribution of sampling sites with severe pollution of Hg (the concentration exceeding 0.100 mg/kg).

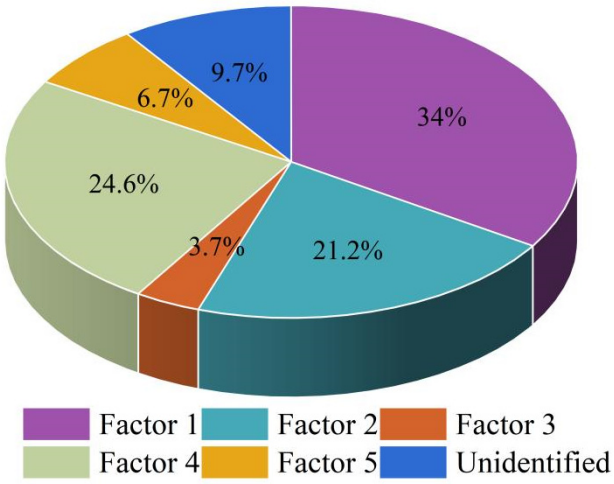

Figure S4. The contribution of different sources to the total metal contents.

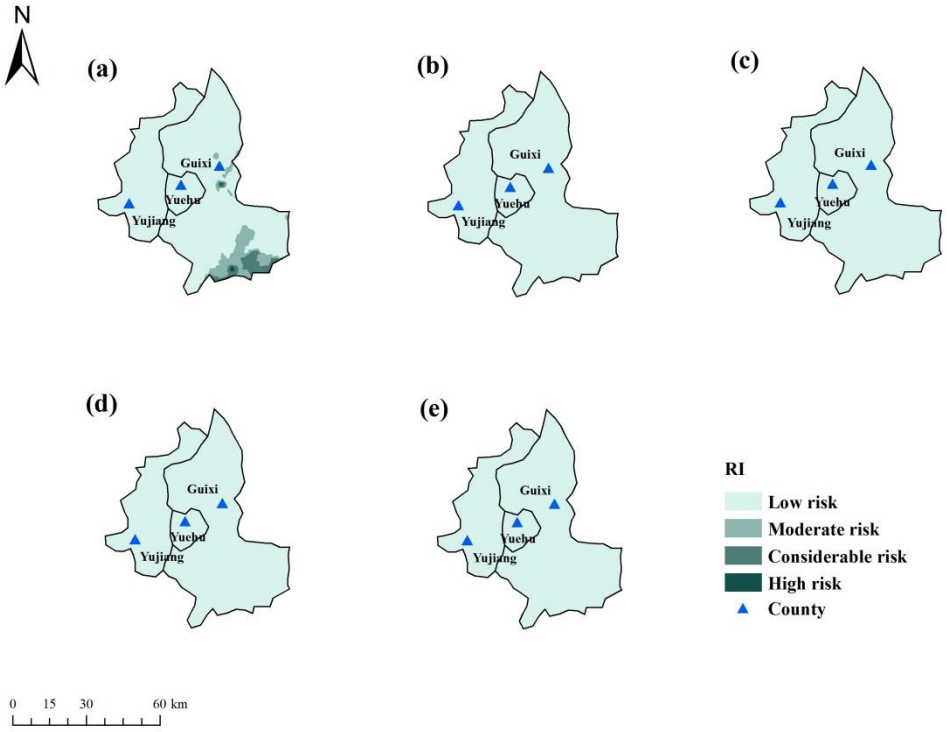

Figure S5. The spatial distribution of RI from different sources.

Reference

Gujre, N., Mitra, S., Soni, A., Agnihotri, R., Rangan, L., Rene, E.R. and Sharma, M.P. 2021. Speciation, contamination, ecological and human health risks assessment of heavy metals in soils dumped with municipal solid wastes. Chemosphere 262, 128013.

Jiang, Y., Wen, H., Zhang, Q., Yuan, L. and Liu, L. 2022. Source apportionment and health risk assessment of potentially toxic elements in soil from mining areas in northwestern China. Environ. Geochem. Health, 1-16.

Liu, Y.P., Cao, X.D., Hu, Y.A. and Cheng, H.F. 2022. Pollution, Risk and Transfer of Heavy Metals in Soil and Rice: A Case Study in a Typical Industrialized Region in South China. Sustainability 14(16), 16.

Sun, Z.H., Hu, Y.N. and Cheng, H.F. 2020. Public health risk of toxic metal(loid) pollution to the population living near an abandoned small-scale polymetallic mine. Sci. Total Environ. 718, 13.

USEPA, 2002. Risk-based Concentration Table. U.S. Environmental Protection Agency, Washington, DC.

USEPA, 2011. Exposure Factors Handbook 2011 Edition (Final). U.S. Environmental Protection Agency, Washington, DC.